

CDS130 Mid-term exam

- Write your name at the top of your answer page.
- This is a closed book exam.
- You may not use a calculator.
- You may not use MATLAB during exam except the last two problems.
- Absolutely no interaction between students is allowed.
- Partial credit may be awarded ONLY if work is shown.
- Duration for this exam: 75 minutes.

Q1. (5 points)

$(-7)_{10} = (\quad)_2$ (using the excess-127 method) .

Answer:

Q2. (5 points) Convert decimal -127 to 8-bit binary using the two's complement method .

Answer:

Q3. (5 points) How many bits are needed to generate 1048 bit-patterns?

Answer:

Q4. (5 points) Carry out binary division and find the results of
0 1 1 1 0 0 0 1 1 divided by 0 1 1 0 1

Q5. (5 points) There are three different computer types on the Voyager spacecraft and there are two of each kind. Total number of words among the six computers is about 32, 000.

Computer Command System (CCS) - 18-bit word, interrupt type processors (2) with 4096 words each of the memory plates.

Flight Data System (FDS) - 16-bit word machine (2) with 8198 words each

Attitude and Articulation Control System (AACS) - 18-bit word machines (2) with 4096 words each.

How much memory (in terms of bytes) is equipped on the Voyager spacecraft?

Q6. (5 points) A forensic computer scientist is able to examine a file at the low-level of bytes for analyzing malware. A snippet of the document with the binary format reads:

0101 0011 0110 1000 0101 0101 0111 0100

0100 0100 0110 1111 0101 0111 0110 1110

What is the content of the document displayed above according to the ASCII encoding table?

Dec	Hex	Name	Char	Ctrl-char	Dec	Hex	Char	Dec	Hex	Char	Dec	Hex	Char
0	0	Null	NUL	CTRL-@	32	20	Space	64	40	@	96	60	`
1	1	Start of heading	SOH	CTRL-A	33	21	!	65	41	A	97	61	a
2	2	Start of text	STX	CTRL-B	34	22	"	66	42	B	98	62	b
3	3	End of text	ETX	CTRL-C	35	23	#	67	43	C	99	63	c
4	4	End of xmit	EOT	CTRL-D	36	24	\$	68	44	D	100	64	d
5	5	Enquiry	ENQ	CTRL-E	37	25	%	69	45	E	101	65	e
6	6	Acknowledge	ACK	CTRL-F	38	26	&	70	46	F	102	66	f
7	7	Bell	BEL	CTRL-G	39	27	'	71	47	G	103	67	g
8	8	Backspace	BS	CTRL-H	40	28	(	72	48	H	104	68	h
9	9	Horizontal tab	HT	CTRL-I	41	29	)	73	49	I	105	69	i
10	0A	Line feed	LF	CTRL-J	42	2A	*	74	4A	J	106	6A	j
11	0B	Vertical tab	VT	CTRL-K	43	2B	+	75	4B	K	107	6B	k
12	0C	Form feed	FF	CTRL-L	44	2C	,	76	4C	L	108	6C	l
13	0D	Carriage feed	CR	CTRL-M	45	2D	-	77	4D	M	109	6D	m
14	0E	Shift out	SO	CTRL-N	46	2E	.	78	4E	N	110	6E	n
15	0F	Shift in	SI	CTRL-O	47	2F	/	79	4F	O	111	6F	o
16	10	Data line escape	DLE	CTRL-P	48	30	0	80	50	P	112	70	p
17	11	Device control 1	DC1	CTRL-Q	49	31	1	81	51	Q	113	71	q
18	12	Device control 2	DC2	CTRL-R	50	32	2	82	52	R	114	72	r
19	13	Device control 3	DC3	CTRL-S	51	33	3	83	53	S	115	73	s
20	14	Device control 4	DC4	CTRL-T	52	34	4	84	54	T	116	74	t
21	15	Neg acknowledge	NAK	CTRL-U	53	35	5	85	55	U	117	75	u
22	16	Synchronous idle	SYN	CTRL-V	54	36	6	86	56	V	118	76	v
23	17	End of xmit block	ETB	CTRL-W	55	37	7	87	57	W	119	77	w
24	18	Cancel	CAN	CTRL-X	56	38	8	88	58	X	120	78	x
25	19	End of medium	EM	CTRL-Y	57	39	9	89	59	Y	121	79	y
26	1A	Substitute	SUB	CTRL-Z	58	3A	:	90	5A	Z	122	7A	z
27	1B	Escape	ESC	CTRL-[	59	3B	;	91	5B	[	123	7B	{
28	1C	File separator	FS	CTRL-\	60	3C	<	92	5C	\	124	7C	|
29	1D	Group separator	GS	CTRL-]	61	3D	=	93	5D	]	125	7D	}
30	1E	Record separator	RS	CTRL-^	62	3E	>	94	5E	^	126	7E	~
31	1F	Unit separator	US	CTRL-`	63	3F	?	95	5F	_	127	7F	DEL

Q7. (5 points) Suppose signed integers are represented by 11 bits in a computer architecture. Show respectively the range of the integers (in base 10) in the following methods:

(1) Sign-and-magnitude

(2) One's complement

(3) Two's complement

(4) Excess - 1023.

Q8. (5 points) If we use 8 bits for signed integers, show how we would solve the problem of subtracting 70_{10} from 30_{10} using 2's complement.

Q9. (5 points) How many zeroes are in the binary representation of the decimal number resulting from the sum of $2^{13} + 2^7 + 1$?

Q10. (5 points) Suppose Matlab uses 64 bits to represent real numbers and 16 bits for characters, what is the size of A, B, C, D (in terms of bytes, respectively) if the following commands are executed?

`A(2:6) = 2:6`

`B = 'cds130'`

`C = int16(B)`

`D = 1:3:301`

Answer:

Q11. (5 points) Use a single command to create a matrix (assign it to a variable named B) such that

`B = [1, 1/4, 1/9, 1/16, 1/25, 1/36]`

DO NOT type the vector explicitly.

Q12. (10 points) What is the output after executing the following MATLAB code:

```
clear all;
first_variable = 4;
second_variable = 3;
third_variable = 12;
vector_created1 ( first_variable) = second_variable
vector_created2 (second_variable) = first_variable
vector_created3 = [vector_created1, vector_created2] + third_variable
```

Q13. (10 points) What is the output after executing the following MATLAB code:

```
clear;

mat1 = [2:5]*2
mat2 = [2:-1: -1].^2
mat3 = mat2 ./ mat1;
mat3
```

Q14. (10 points) An anonymous function defined in matlab is a function that is not stored in a program file, but associated with a variable.

$$f(x, y) = \sin^2(x^2) + \cos^2(y^2) + e^{x-y}$$

Calculate the values of $f(f(0.3, 0.4), f(0.2, 0.1))$ using the defined anonymous function in Matlab.

Q15. (15 points) Write a script called 'exam.m' that asks the user to

- (1) provide three numbers and name them as variables x, y, and z;
- (2) write a user-defined function `my_power(x,y,z)` to evaluate the value of $x^y - x^z$
- (3) use the user-provided values to test the results of this function and show the results.

Present your matlab code.